Non-Darcy Flow Behavior near High-Flux Injection Wells

in Porous and Fractured Formations

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Abstract

This paper presents a study of non-Darcy fluid flow through porous and fractured rock, which may occur during high-flux injection of waste fluids into underground formations. Both numerical and analytical models are used in this study and the non-Darcy flow is described using the *Forchheimer* equation, implemented in a three-dimensional, multiphase flow reservoir simulator. The non-Darcy flow through fractured reservoir is handled using a general dual continuum approach, covering commonly used conceptual models, such as double porosity, dual permeability, explicit fracture, etc. Under single-phase flow condition, an approximate analytical solution, as an extension of the Warren-Root solution, is discussed.

The objectives of this study are (1) to obtain insights into the effect of non-Darcy flow on transient pressure behavior through porous and fractured reservoirs and (2) to provide type curves for well test analyses of non-Darcy flow wells. The type curves generated include various types of drawdown, injection, and buildup tests with non-Darcy flow occurring in porous and fractured reservoirs. In addition, non-Darcy flow into partially penetrating wells is also considered. The transient pressure type curves for flow in fractured reservoirs are based on the double-porosity model. Furthermore, a simple graphic approach for determining formation non-Darcy flow coefficients by well testing is presented. These type curves provided in this work for non-Darcy flow in porous and fractured reservoirs will find their applications in well test interpretation using the type-curve matching technique.